

REMARKS

In the office action, the Examiner indicated that the specification was objected to for lack of clarity, and has requested that a substitute specification be submitted in this case under 37 C.F.R. 1.125.

In a telephone call with the Examiner on January 15, 2004, it was noted that a substitute specification and marked up version of the application were previously filed in the application on August 14, 2003. The Examiner indicated that these materials may not have been clear enough. Therefore, the Applicant is submitting as attachment A, a substitute specification in conformity with the requirements of 37 C.F.R. 1.125, as amended July 30, 2003. The computer printout appears to be clear and should be satisfactory.

The undersigned submits that the substitute specification includes no new matter.

As per the discussions with the Examiner which took place on January 15, 2004, a marked up version of the specification is no longer required in this case, as one was previously filed on August 14, 2003.

A listing of the claims as they presently stand is set forth above. Claims 1-12 are pending in the application. Given that the listing of claims above is clear, the objection to claim 5 should now be withdrawn.

For purposes of completeness a substitute Abstract of the Disclosure is provided as attachment C. No new matter is added, and the substitute Abstract of the Disclosure reflects the Abstract as revised in the amendment of August 14, 2003.

Claims 1-12 were rejected under 35 U.S.C. § 102(a) as being anticipated by Russian Patent No. RU 2 174 165 C1 to Volokitin et al. The Applicants respectfully traverse such rejection on the basis that RU 2 174 165 C1 was published September 27, 2001, whereas the date of priority for the claimed invention is March 12, 2001, which is the date of application for German Patent No. 101 12 089.3 to the Applicants.

As can be seen from the declaration paper of the present application, this

application claims priority to German Application 10112089.3 filed March 12, 2001. A certified copy of German Application 10112089.3 was filed in the USPTO on September 26, 2002.

Attached as attachment B is a verified translation of the text of German Application 10112089.3 as it was transmitted to the undersigned from the German Law firm of Gramm, Lins & Partner on July 30, 2001. In attachment B are (1) a verification paper executed by a person competent to translate from German to English executed by Mr. Allen Cooperman, (2) an English language translation of the claims and patent specification which correspond to German Application 10112089.3, and (3) a copy of the transmittal letter from Gramm, Lins & Partner dated July 30, 2001.

A comparison of the drawings and text of the German Patent Application 101 12 089.3 with those of the present application shows that the drawings and text are essentially the same. Further, a comparison of the claims of German Patent Application 101 12 089.3 with those of the present application shows that each and every claim of the claimed invention is supported by the claims of German Patent No. 101 12 089.3, as set forth below:

German Patent No. 101 12 089.3		U.S. Patent Application No. 09/988,061	
Claim	Certified English Translation	Claim	Text
1	A device for producing synthetic fiber materials, with a polymer melt feed leading to a rotating hollow reactor (1), whose wall can be heated and which widens conically in order to guide a film melt toward an open side that can be closed with a lid (13), and with ribs (4) for dividing the melt film into fibers that grow rigid after leaving the hollow reactor (1), wherein the hollow reactor (1) is vertically oriented and exhibits on its curved upper side an opening (3) for introducing the polymer melt, while a rotating distributor plate (12) is positioned opposite the opening (3), at a slight distance from the inner wall of the hollow reactor (1).	1	A device for producing synthetic fiber materials, with a polymer melt feed leading to a rotating hollow reactor, whose wall can be heated and which widens conically in order to guide a film melt toward an open side that can be closed with a lid, and with ribs for dividing the melt film into fibers that grow rigid after leaving the hollow reactor, wherein the hollow reactor is vertically oriented and exhibits on its curved upper side an opening for introducing the polymer melt, while a rotating distributor plate is positioned opposite the opening, at a slight distance from the inner wall of the hollow reactor.
2	A device according to claim 1, wherein the distance between the distributor plate (12) and the inner wall of the hollow reactor (1) can be adjusted.	2	A device according to claim 1, wherein the distance between the distributor plate and the inner wall of the hollow reactor can be adjusted.
3	A device according to claim 1 or 2, wherein the distributor plate (12) exhibits a surface that faces the opening (3) and that rises toward the rim.	3	A device according to claim 1, wherein the distributor plate exhibits a surface that faces the opening and that rises toward the rim.
4	A device according to claim 3, wherein the distributor plate (12) exhibits an upper side that curves in concave fashion and faces the opening (3).	4	A device according to claim 1, wherein the distributor plate exhibits an upper side that curves in concave fashion and faces the opening.

German Patent No. 101 12 089.3		U.S. Patent Application No. 09/988,061	
Claim	Certified English Translation	Claim	Text
5	A device according to one of claims 1 to 4, wherein a truncated cone (11) whose outer diameter is smaller than the diameter of the distributor plate (12) is positioned on said distributor plate (12).	5	A device according to claim 1, wherein a truncated cone whose outer diameter is smaller than the diameter of the distributor plate is positioned on said distributor plate.
6	A device according to claim 5, wherein the diameter of the truncated cone (11) is on the same order of magnitude as the diameter of the opening (3) of the feed.	6	A device according to claim 5, wherein the diameter of the truncated cone is on the same order of magnitude as the diameter of the opening of the feed.
7	A device according to one of claims 1 to 6, wherein the inner wall of the hollow reactor (1) is parabolic in shape.	7	A device according to claim 1, wherein the inner wall of the hollow reactor is parabolic in shape.
8	A device according to one of claims 1 to 7, wherein the ribs (4) on the inner wall of the hollow reactor (1) run vertical to the rim (2) in the lower area.	8	A device according to claim 1, wherein the ribs on the inner wall of the hollow reactor run vertical to the rim in the lower area.
9	A device according to one of claims 1 to 8, wherein the hollow reactor (1), together with a surrounding container (5), forms a curved gap (6), to which a steam feed and a steam outlet are attached.	9	A device according to claim 1, wherein the hollow reactor, together with a surrounding container, forms a curved gap, to which a steam feed and a steam outlet are attached.
10	A device according to claim 9, wherein the steam feed and the steam outlet are positioned on the upper and lower rim of the hollow reactor (1).	10	A device according to claim 9, wherein the steam feed and the steam outlet are positioned on the upper and lower rim of the hollow reactor.
11	A device according to claim 9 or 10, wherein the steam is guided through the gap (6) in circulating fashion.	11	A device according to claim 9, wherein the steam is guided through the gap in circulating fashion.

German Patent No. 101 12 089.3		U.S. Patent Application No. 09/988,061	
Claim	Certified English Translation	Claim	Text
12	A device according to claim 11, wherein the steam is conducted through the curved gap (6) in the same direction as the melt flowing as a film on the inner wall of the hollow reactor (1).	12	A device according to claim 11, wherein the steam is conducted through the curved gap in the same direction as the melt flowing as a film on the inner wall of the hollow reactor.

Because the publication date of RU 2,174,165 is September 27, 2001, and this date is after the priority date of the present application, which is March 12, 2001, RU 2,174,165 is not an effective reference under 35 U.S.C. 102(a), and the rejection should now be withdrawn.

In view of the above, claims 1-12 are in *prima facie* condition for allowance. Reconsideration and allowance of the claims at an early date is requested.

Applicant hereby makes a written conditional petition for extension of time, if required. Please charge any deficiencies in fees and credit any overpayment in fees to Attorney's Deposit Account No. 50-2041 (Whitham, Curtis & Christofferson P.C.).

Respectfully submitted,



Michael E. Whitham
Reg. No. 32,635

Whitham, Curtis & Christofferson, P.C.
11491 Sunset Hills Road, Suite 340
Reston, VA, 20190
Customer Number 30743
Phone: 703-787-9400
Fax: 703-787-7557

A DEVICE FOR FORMING SYNTHETIC FIBER MATERIALS

DESCRIPTION

BACKGROUND OF THE INVENTION

Field of the Invention

1. The invention relates to a device for producing synthetic fiber materials, with a polymer melt feed leading to a rotating hollow reactor, the wall of which can be heated and which widens conically in order to guide a film melt toward an open side that can be closed with a lid, and with ribs for dividing the melt film into fibers that grow rigid after leaving the hollow reactor.

Background Description

2. Synthetic fibrous materials with a polymer melt feed can be employed in particular as absorption agents that filter mineral oil and oil products, as well as a series of heavy metal ions, out of water. The process for manufacturing thermoplastic fibrous material usually involves two stages, namely the production of the melt and the formation of the fibers.

3. In known facilities, the thermoplastic material is first melted and the melt is then extruded through spinnerets in order to form the fibers. An apparatus known from SU 1 236 020 A exhibits a loading bin, a current supply, and a melt lattice, with a distributor for heated inert gas. The distributors are triangular in shape and are positioned uniformly over the melt lattice forming the surface. In the space above the lattice the thermoplastic material being processed is uniformly heated to a temperature close to the melting point and can then pass without hindrance between the triangular distributors, in the process of which there is a treatment with nitrogen. Connection points for mounting heating elements are located in the housing for the melt lattice. The heated material is thus melted and in turn reaches a worm gear and is pressed through the

nozzles and formed into a skein or a thread. With facilities of this kind fibers can only be produced from high-quality raw materials, and an even rhythm must be assured when the raw material reaches the melt lattice and as the melt reaches the worm for removal.

4. Facilities are known from GB 1 265 215 and SU 669 041 A in which the fibers are produced from a melt strip, so that the uniformity of the melt throughput is not critical. Here the strip from the melt is divided into individual skeins at the edge of the rotating reactor. The reactor is a horizontally positioned, two-part basin with a hollow space and a working surface. Located in the hollow space are gap-like openings. An energy carrier penetrates from the outer cavity of the reactor through the gap-like openings and divides the melt strip into individual skeins, works them from two sides, makes them thinner, and draws them into fibers. In order to obtain a high-quality fiber with this apparatus the energy carrier must have a higher temperature than the melting temperature of the polymer, as well as a adequate speed, so that the melt skeins can grow thinner and longer and thus be formed into a fiber. The opened reactor basin results in an energy loss and diminishes the effectiveness of the manufacturing process.
5. Known from RU 2 061 129, furthermore, is an apparatus for producing fiber materials which exhibits an extruder, a circular head that forms a thread and is provided with radially positioned channels that run together in the center, and air current generator which simultaneously draws out the melt skeins lengthwise and cools them until they have become fibers, and an element for cutting the finished fibers that exhibits an extension converging in the direction of the arriving thread. The fibers are deposited under the influence of a stiff air current, which is aimed in the direction of the extruded melt skeins. The radially positioned channels that run together in the middle also require the use of high-quality raw materials. Otherwise these channels become blocked with a mass of material that is not fully melted, and this makes further transport through the melt liens more difficult. The production of high-quality fibers from raw materials of lower quality is thus impossible.
6. Known from RU 2 117 719 is a device of the initially mentioned type, in which a horizontally positioned, rotating, cylindrical hollow reactor is externally heated. The open part of the reactor has the form of a cone which increases in size and is sealed with an immovable lid. The cone lid, together with the lateral surfaces of the widening cone, forms a gap of 15 to

20 mm. In addition, the inner surface of the reactor is provided with flat ribs that have a triangular form over their length; the ribs are oriented in the direction of the fiber formation and point toward the melt outlet.

7. The device is equipped with a circular high-pressure air supply. With this known device it is possible to process thermoplastic material consisting of industrial and domestic refuse while simultaneously increasing the output of high-quality fiber material. In actual practice, however, a problem arises in that with conventional heating elements and a cylindrically shaped reactor it is impossible to uniformly heat the reactor wall and floor.

8. Consequently the temperature of the reactor floor and of the terminal components are always lower than the reactor wall. The melt collects in the corners between the wall and the floor and thus forms a kind of standstill area, where the melt cools and tends to stick to the floor and the transitional areas between the floor and the walls. The formation of such standstill areas diminishes the productivity of the apparatus and has a negative effect on the fiber quality. Solid parts of the polymer can be drawn out of the standstill area and transported, together with the melt, to the terminal part of the reactor under the effect of centrifugal forces, to be released along with the fiber. The result is that the fibers are formed unevenly, with thickened areas or inclusions of solid, unmelted pieces that vary in shape; the quality of the fibers is thus diminished.

9. To clean the standstill area the facility must be regularly shut down and the adhering polymer mechanically removed. If the reactor walls were heated to a greater degree this would lead to considerable overheating of the melt film. Another disadvantage of the known device rests in the fact that more than 30% of the introduced heat energy is directly employed in heating the strip. The residual energy released by the heater is consumed in heating the reactor interior and the ambient air through the transfer of radiation energy.

10. Furthermore, due to the back radiation between the heater and the reactor in the central part of the reactor the heating elements and the melt strip become overheated. This may result in the heater being burned and to the partial or complete burnout of the polymer. When there is a uniform distribution of the heater capacity in the radial and axial direction, the main quantity of heat gathers in the upper portion of the heater. In this case, overheating and burning of the

heating elements is also possible.

SUMMARY OF THE INVENTION

11. The present invention is based on the problem of improving a device of the initially indicated type for the manufacture of synthetic fiber materials and in such a way that the fiber quality is improved while the energy consumption is reduced.
12. The invention solves this problem in a device of the initially indicated type in that the hollow reactor is vertically oriented and exhibits a continuously curved inner wall and an opening on the curved upper side of the wall to introduce the polymer melt and in that a rotating distributor plate is positioned opposite the opening, at a slight distance from the inner wall.
13. The device according to the invention is designed for the production of a uniformly thin melt film which can move to the open side of the reactor due to the continuous curve of the inner wall, without the presence of standstill areas. The uniformly thin film is successfully formed in that the polymer melt is fed axially through an opening on the curved upper side of the hollow reactor and there reaches a rotating distributor plate, which is positioned at a slight distance from the inner wall of the hollow reactor. The fed molten polymer is thus collected and flung evenly onto the inner wall of the hollow reactor by centrifugal force. The distributor plate thus creates a seal for the supply opening while forming an annular gap with the inner wall of the hollow reactor, and the material collected on the distributor plate leaves this annular gap in evenly distributed form and reaches the inner wall of the hollow reactor. The speed of flow of the melt film on the inner wall of the hollow reactor is determined by the centrifugal force resulting from the rotation of the hollow reactor and additionally by the weight of the melt film, since the hollow reactor is vertically oriented and open below.
14. The distribution effect of the distributor plate is further improved in that the surface of the distributor plate rises toward the rim and will ideally form a curved surface that is concave in the direction of the opening. In a preferred embodiment a truncated cone is positioned on the distributor plate; the diameter of this truncated cone is smaller than the diameter of the distributor plate. Here the diameter of the upper side of the distributor plate can correspond in terms of

magnitude to the diameter of the opening of the feed opening.

15. The continuously curved inner wall of the hollow reactor will ideally be parabolic in shape and will thus correspond to the surface that arises when a parabola is rotated around its own axis. Given the same height and the same diameter of the outlet opening, the continuous curve provides a considerably reduced inner volume compared to the known device, so that the quantity of heat energy required for heating the inner space is reduced. The invention design also minimizes the heat losses and the specific heat consumption.

16. In a particularly preferred embodiment of the invention the inner wall forms a curved gap in conjunction with a container surrounding the hollow reactor, to which a steam feed and a steam outlet are attached. The continuous circulation of heated water vapor through the hollow space results in the uniform heating of the reactor walls. It is thus possible to produce the melt strip or the melt film at a uniform temperature and thickness, with the result that the fiber exhibits a uniform diameter over its entire length and has no unmelted parts. To this end it is expedient for the steam feed and the steam outlet to be positioned on the upper and lower rim of the inner wall. The steam can then be guided in the polymer melt's direction of flow, as well as in the opposite direction.

BRIEF DESCRIPTION OF THE DRAWINGS

17. The foregoing and other objects, aspects and advantages will be better understood from the following detailed description of a preferred embodiment of the invention with reference to the drawings, in which:

18. Fig. 1 depicts a vertical section through an exemplary embodiment of a device according to the invention.

19. Fig. 2 depicts a partial view of the annular gap formed between the inner wall and the lid of Fig. 1.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

20. The device shown in the drawing serves to produce fibers from a thermoplastic melt and comprises a vertically installed rotating hollow reactor 1 in the form of a paraboloid, which is created by rotating a parabola around its own axis. Provided on the open rim of the paraboloid is a rim 2 that widens to form a cone. Centrally positioned in the curved portion of the paraboloid is an opening 3 for introducing a polymer melt. The inner wall of the hollow reactor 1 is provided with flat ribs 4, which run vertical to the rim 2 in the lower area of the hollow reactor 1.

21. The hollow reactor 1 is located in a container 5 that encloses it and whose surface accommodates the shape of the hollow reactor 1 in such a way as to produce a curved gap 6. The upper part of the gap 6 is connected to the outlet and the lower part of the gap 6 to the intake of a steam generator 7, with the result that a closed steam circuit is formed by the gap 6. The direction of movement of the water vapor is indicated by the arrow in figure 1; here there is a uni-directional flow of the water vapor. By reversing the steam generator 7 it is likewise possible, and for some applications it is expedient, to also provide a counter-directional flow of the water vapor.

22. Located inside the hollow reactor 1, opposite the opening 3, is a distributor configuration 8 which is secured to a rod 9 running centrally through the feed opening 3. The rod 9 is axially adjustable, so that the distance of the distributing device 8 from the inner wall of the hollow reactor 1 can be adjusted. In the depicted exemplary embodiment the distributing device 8 consists of a truncated cone 11 and a distributor plate 12 positioned beneath it; the diameter of the distributor plate 12 is greater than the base of the truncated cone 11. The truncated cone 11 and the distributor plate 12 are securely joined and will ideally consist of a single piece. The radial portion of the distributor plate 12 extending beyond the truncated cone 11 is provided with a surface that rises as it approaches the rim and thus forms an upper surface that curves in concave fashion.

23. The hollow reactor 1 is closed at its lower, open end by a disk-shaped lid 13. The flat ribs 4 are connected to the rim of the lid 13, so that there are outlet holes between the ribs. The

hollow reactor is attached to the end of a hollow shaft 14, which is mounted on bearings 15 in rotating fashion. The bearings 15 are located in a housing 16 that requires cooling. Positioned at the end of the shaft 14 that is removed from the hollow reactor 1 is a drive disk 17 for transmitting the rotation of, e.g., an asynchronous motor (not shown).

24. To produce fiber materials the reactor is brought to operating temperature before startup by feeding the circulating water vapor into the gap 6. Since the flow of water vapor has a constant temperature and speed, the inner wall of the hollow reactor 1 is evenly heated over its entire surface. The heat flow is drawn inward from the heated surface of the hollow reactor 1 and thus produces the necessary temperature in the entire inner space and keeps it constant. A homogeneous temperature field thus arises over the entire surface of the hollow reactor 1.

25. After the apparatus is prepared in this way the hollow reactor is made to rotate at a predetermined angular speed. The polymer melt is then introduced through the hollow shaft 14 and the annular distributor gap 10. The melt first reaches the truncated cone 11 and then flows over the distributor plate 12. The speed of the melt flow increases due to the conicity of the truncated cone 11. This speed increases as the melt runs to the edge of the distributor plate 12. The distributor plate 12 thus represents a kind of collecting device which allows the melt to become evenly distributed over the entirety of the plate. Since the surface of the distributor plate 12 rises toward the rim, an additional thickening force arises, such that the melt moves as a homogeneous strip to the periphery of the distributor plate with increasing speed and force. After reaching the rim of the distributor plate 12 the melt strip tears apart and reaches the inner wall of the hollow reactor 1. There the melt film moves downward, the downward motion being supported by the gravitational force brought into play by the vertical design of the hollow reactor 1. After reaching the part of the hollow reactor where the flat ribs 4 are located, the melt film divides into various skeins, which run over the rim 2 and form thin fibers when torn from the edge of the conical rim 2. The threads that have thus arisen and are in the process of cooling are guided into a collecting device by an annular air feed.

26. While the invention has been described in terms of a single preferred embodiment, those skilled in the art will recognize that the invention can be practiced with modification within the spirit and scope of the appended claims.



TRANSEMANTICS, INC.

TRANSLATION DIVISION

4301 Connecticut Avenue, N.W.

Suite 146

Washington, D.C. 20008 USA

Tel phone: (202) 686-5600

Facsimile: (202) 686-5603

CERTIFICATION

This is to certify that the translation of:

- Patent Application referenced 3129-002 US-1 and dated July 30, 2001, on Gramm, Lins & Partners letterhead, is a true and accurate translation from German into English to the best of my knowledge and belief.

Allen Cooperman

1/08/2004

Gramm, Lins & Partners
Patent Attorneys and Attorneys at Law
Association under Civil Law

[Letterhead information]

Gramm, Lins & Partners
Theodore-Heuss-Str. 1, D38122 Braunschweig
Microfaser Produktionsgesellschaft mbH
Steinweg 60
38518 Gifhorn

Your ref.:

Our ref:
3129-002 US-1

Date:
July 30, 2001

Patent Claims

1. A device for producing synthetic fiber materials, with a polymer melt feed leading to a rotating hollow reactor (1), whose wall can be heated and which widens conically in order to guide a film melt toward an open side that can be closed with a lid (13), and with ribs (4) for dividing the melt film into fibers that grow rigid after leaving the hollow reactor (1), wherein the hollow reactor (1) is vertically oriented and exhibits on its curved upper side an opening (3) for introducing the polymer melt, while a rotating distributor plate (12) is positioned opposite the opening (3), at a slight distance from the inner wall of the hollow reactor (1).
2. A device according to claim 1, wherein the distance between the distributor plate (12) and the inner wall of the hollow reactor (1) can be adjusted.
3. A device according to claim 1 or 2, wherein the distributor plate (12) exhibits a surface that faces the opening (3) and that rises toward the rim.
4. A device according to claim 3, wherein the distributor plate (12) exhibits an upper side that curves in concave fashion and faces the opening (3).
5. A device according to one of claims 1 to 4, wherein a truncated cone (11) whose outer diameter is smaller than the diameter of the distributor plate (12) is positioned on said distributor plate (12).
6. A device according to claim 5, wherein the diameter of the truncated cone (11) is on the same order of magnitude as the diameter of the opening (3) of the feed.
7. A device according to one of claims 1 to 6, wherein the inner wall of the hollow reactor (1) is parabolic in shape.
8. A device according to one of claims 1 to 7, wherein the ribs (4) on the inner wall of the hollow reactor (1) run vertical to the rim (2) in the lower area.
9. A device according to one of claims 1 to 8, wherein the hollow reactor (1), together with a surrounding container (5), forms a curved gap (6), to which a steam feed and a steam outlet are attached.

10. A device according to claim 9, wherein the steam feed and the steam outlet are positioned on the upper and lower rim of the hollow reactor (1).
11. A device according to claim 9 or 10, wherein the steam is guided through the gap (6) in circulating fashion.
12. A device according to claim 11, wherein the steam is conducted through the curved gap (6) in the same direction as the melt flowing as a film on the inner wall of the hollow reactor (1).

Gramm, Lins & Partners
Li/ho

Gramm, Lins & Partners
Patent Attorneys and Attorneys at Law
Association under Civil Law

[Letterhead information]

Gramm, Lins & Partners
Theodore-Heuss-Str. 1, D38122 Braunschweig
Microfaser Produktionsgesellschaft mbH
Steinweg 60
38518 Gifhorn

Your ref.:

Our ref:
3129-002 US-1

Date:
July 30, 2001

The invention relates to a device for producing synthetic fiber materials, with a polymer melt feed leading to a rotating hollow reactor, the wall of which can be heated and which widens conically in order to guide a film melt toward an open side that can be closed with a lid, and with ribs for dividing the melt film into fibers that grow rigid after leaving the hollow reactor.

Synthetic fibrous materials of this kind can be employed in particular as absorption agents that filter mineral oil and oil products, as well as a series of heavy metal ions, out of water.

The process for manufacturing thermoplastic fibrous material usually involves two stages, namely the production of the melt and the formation of the fibers.

In known facilities, the thermoplastic material is first melted and the melt is then extruded through spinnerets in order to form the fibers. An apparatus known from SU 1 236 020 A exhibits a loading bin, a current supply, and a melt lattice, with a distributor for heated inert gas. The distributors are triangular in shape and are positioned uniformly over the melt lattice forming the surface. In the space above the lattice the thermoplastic material being processed is uniformly heated to a temperature close to the melting point and can then pass without hindrance between the triangular distributors, in the process of which there is a treatment with nitrogen. Connection points for mounting heating elements are located in the housing for the melt lattice. The heated material is thus melted and in turn reaches a worm gear and is pressed through the nozzles and formed into a skein or a thread. With facilities of this kind fibers can only be produced from high-quality raw materials, and an even rhythm must be assured when the raw material reaches the melt lattice and as the melt reaches the worm for removal.

Facilities are known from GB 1 265 215 and SU 669 041 A in which the fibers are produced from a melt strip, so that the uniformity of the melt throughput is not critical. Here the strip from the melt is divided into individual skeins at the edge of the rotating reactor. The reactor is a horizontally positioned, two-part basin with a hollow space and a working surface. Located in the hollow space are gap-like openings. An energy carrier penetrates from the outer cavity of the reactor through the gap-like openings and divides the melt strip into individual skeins, works them from two sides, makes them thinner, and draws them into fibers. In order to obtain a high-quality fiber with this apparatus the energy carrier must have a higher temperature than the melting temperature of the polymer, as well as a adequate speed, so that the melt skeins can grow thinner and longer and thus be formed into a fiber. The opened reactor basin results in an energy loss and diminishes the effectiveness of the manufacturing process.

Known from RU 2 061 129, furthermore, is an apparatus for producing fiber materials which exhibits an extruder, a circular head that forms a thread and is provided with radially positioned channels that run together in the center, an air current generator which simultaneously

draws out the melt skeins lengthwise and cools them until they have become fibers, and an element for cutting the finished fibers that exhibits an extension converging in the direction of the arriving thread. The fibers are deposited under the influence of a stiff air current, which is aimed in the direction of the extruded melt skeins. The radially positioned channels that run together in the middle also require the use of high-quality raw materials. Otherwise these channels become blocked with a mass of material that is not fully melted, and this makes further transport through the melt lines more difficult. The production of high-quality fibers from raw materials of lower quality is thus impossible.

Known from RU 2 117 719 is a device of the initially mentioned type, in which a horizontally positioned, rotating, cylindrical hollow reactor is externally heated. The open part of the reactor has the form of a cone which increases in size and is sealed with an immovable lid. The cone lid, together with the lateral surfaces of the widening cone, forms a gap of 15 to 20 mm. In addition, the inner surface of the reactor is provided with flat ribs that have a triangular form over their length; the ribs are oriented in the direction of the fiber formation and point toward the melt outlet. The device is equipped with a circular high-pressure air supply. With this known device it is possible to process thermoplastic material consisting of industrial and domestic refuse while simultaneously increasing the output of high-quality fiber material. In actual practice, however, a problem arises in that with conventional heating elements and a cylindrically shaped reactor it is impossible to uniformly heat the reactor wall and floor. Consequently the temperature of the reactor floor and of the terminal components are always lower than the reactor wall. The melt collects in the corners between the wall and the floor and thus forms a kind of standstill area, where the melt cools and tends to stick to the floor and the transitional areas between the floor and the walls. The formation of such standstill areas diminishes the productivity of the apparatus and has a negative effect on the fiber quality. Solid parts of the polymer can be drawn out of the standstill area and transported, together with the melt, to the terminal part of the reactor under the effect of centrifugal forces, to be released along with the fiber. The result is that the fibers are formed unevenly, with thickened areas or inclusions of solid, unmelted pieces that vary in shape; the quality of the fibers is thus diminished. To clean the standstill area the facility must be regularly shut down and the adhering polymer mechanically removed. If the reactor walls were heated to a greater degree this would lead to considerable overheating of the melt film. Another disadvantage of the known device rests in the fact that more than 30% of the introduced heat energy is directly employed in heating the strip. The residual energy released by the heater is consumed in heating the reactor interior and the ambient air through the transfer of radiation energy. Furthermore, due to the back radiation between the heater and the reactor in the central part of the reactor the heating elements and the melt strip become overheated. This may result in the heater being burned and to the partial or complete burnout of the polymer. When there is a uniform distribution of the heater capacity in the radial and axial direction, the main quantity of heat gathers in the upper portion of the heater. In this case, overheating and burning of the heating elements is also possible.

The present invention is based on the problem of improving a device of the initially indicated type for the manufacture of synthetic fiber materials and in such a way that the fiber quality is improved while the energy consumption is reduced.

The invention solves this problem in a device of the initially indicated type in that the hollow reactor is vertically oriented and exhibits a continuously curved inner wall and an opening on the curved upper side of the wall to introduce the polymer melt and in that a rotating distributor plate is positioned opposite the opening, at a slight distance from the inner wall.

The device according to the invention is designed for the production of a uniformly thin melt film which can move to the open side of the reactor due to the continuous curve of the inner wall, without the presence of standstill areas. The uniformly thin film is successfully formed in that

the polymer melt is fed axially through an opening on the curved upper side of the hollow reactor and there reaches a rotating distributor plate, which is positioned at a slight distance from the inner wall of the hollow reactor. The fed molten polymer is thus collected and flung evenly onto the inner wall of the hollow reactor by centrifugal force. The distributor plate thus creates a seal for the supply opening while forming an annular gap with the inner wall of the hollow reactor, and the material collected on the distributor plate leaves this annular gap in evenly distributed form and reaches the inner wall of the hollow reactor. The speed of flow of the melt film on the inner wall of the hollow reactor is determined by the centrifugal force resulting from the rotation of the hollow reactor and additionally by the weight of the melt film, since the hollow reactor is vertically oriented and open below.

The distribution effect of the distributor plate is further improved in that the surface of the distributor plate rises toward the rim and will ideally form a curved surface that is concave in the direction of the opening. In a preferred embodiment a truncated cone is positioned on the distributor plate; the diameter of this truncated cone is smaller than the diameter of the distributor plate. Here the diameter of the upper side of the distributor plate can correspond in terms of magnitude to the diameter of the opening of the feed opening.

The continuously curved inner wall of the hollow reactor will ideally be parabolic in shape and will thus correspond to the surface that arises when a parabola is rotated around its own axis. Given the same height and the same diameter of the outlet opening, the continuous curve provides a considerably reduced inner volume compared to the known device, so that the quantity of heat energy required for heating the inner space is reduced. The invention design also minimizes the heat losses and the specific heat consumption.

In a particularly preferred embodiment of the invention the inner wall forms a curved gap in conjunction with a container surrounding the hollow reactor, to which a steam feed and a steam outlet are attached. The continuous circulation of heated water vapor through the hollow space results in the uniform heating of the reactor walls. It is thus possible to produce the melt strip or the melt film at a uniform temperature and thickness, with the result that the fiber exhibits a uniform diameter over its entire length and has no unmelted parts. To this end it is expedient for the steam feed and the steam outlet to be positioned on the upper and lower rim of the inner wall. The steam can then be guided in the polymer melt's direction of flow, as well as in the opposite direction.

The invention will next be described on the basis of an exemplary embodiment depicted in the drawing. Shown are

Figure 1 a vertical section through an exemplary embodiment of a device according to the invention

Figure 2 a partial view of the annular gap formed between the inner wall and the lid

The device shown in the drawing serves to produce fibers from a thermoplastic melt and comprises a vertically installed rotating hollow reactor 1 in the form of a paraboloid, which is created by rotating a parabola around its own axis. Provided on the open rim of the paraboloid is a rim 2 that widens to form a cone. Centrally positioned in the curved portion of the paraboloid is an opening 3 for introducing a polymer melt. The inner wall of the hollow reactor 1 is provided with flat ribs 4, which run vertical to the rim 2 in the lower area of the hollow reactor 1.

The hollow reactor 1 is located in a container 5 that encloses it and whose surface accommodates the shape of the hollow reactor 1 in such a way as to produce a curved gap 6. The upper part of the gap 6 is connected to the outlet and the lower part of the gap 6 to the intake of a

steam generator 7, with the result that a closed steam circuit is formed by the gap 6. The direction of movement of the water vapor is indicated by the arrow in figure 1; here there is a uni-directional flow of the water vapor. By reversing the steam generator 7 it is likewise possible, and for some applications it is expedient, to also provide a counter-directional flow of the water vapor.

Located inside the hollow reactor 1, opposite the opening 3, is a distributor configuration 8 which is secured to a rod 9 running centrally through the feed opening 3. The rod 9 is axially adjustable, so that the distance of the distributing device 8 from the inner wall of the hollow reactor 1 can be adjusted. In the depicted exemplary embodiment the distributing device 8 consists of a truncated cone 11 and a distributor plate 12 positioned beneath it; the diameter of the distributor plate 12 is greater than the base of the truncated cone 11. The truncated cone 11 and the distributor plate 12 are securely joined and will ideally consist of a single piece. The radial portion of the distributor plate 12 extending beyond the truncated cone 11 is provided with a surface that rises as it approaches the rim and thus forms an upper surface that curves in concave fashion.

The hollow reactor 1 is closed at its lower, open end by a disk-shaped lid 13. The flat ribs 4 are connected to the rim of the lid 13, so that there are outlet holes between the ribs.

The hollow reactor is attached to the end of a hollow shaft 14, which is mounted on bearings 15 in rotating fashion. The bearings 15 are located in a housing 16 that requires cooling. Positioned at the end of the shaft 14 that is removed from the hollow reactor 1 is a drive disk 17 for transmitting the rotation of, e.g., an asynchronous motor (not shown).

To produce fiber materials the reactor is brought to operating temperature before startup by feeding the circulating water vapor into the gap 6. Since the flow of water vapor has a constant temperature and speed, the inner wall of the hollow reactor 1 is evenly heated over its entire surface. The heat flow is drawn inward from the heated surface of the hollow reactor 1 and thus produces the necessary temperature in the entire inner space and keeps it constant. A homogeneous temperature field thus arises over the entire surface of the hollow reactor 1.

After the apparatus is prepared in this way the hollow reactor is made to rotate at a predetermined angular speed. The polymer melt is then introduced through the hollow shaft 14 and the annular distributor gap 10. The melt first reaches the truncated cone 11 and then flows over the distributor plate 12. The speed of the melt flow increases due to the conicity of the truncated cone 11. This speed increases as the melt runs to the edge of the distributor plate 12. The distributor plate 12 thus represents a kind of collecting device which allows the melt to become evenly distributed over the entirety of plate. Since the surface of the distributor plate 12 rises toward the rim, an additional thickening force arises, such that the melt moves as a homogeneous strip to the periphery of the distributor plate with increasing speed and force. After reaching the rim of the distributor plate 12 the melt strip tears apart and reaches the inner wall of the hollow reactor 1. There the melt film moves downward, the downward motion being supported by the gravitational force brought into play by the vertical design of the hollow reactor 1. After reaching the part of the hollow reactor where the flat ribs 4 are located the melt film divides into various skeins, which run over the rim 2 and form thin fibers when torn from the edge of the conical rim 2.

The threads that have thus arisen and are in the process of cooling are guided into a collecting device by an annular air feed.

Li/ho

Summary

Fibers of improved quality can be produced with a reduced energy input in a device for producing synthetic fiber materials which has a polymer melt feed leading to a rotating hollow reactor (1), the wall of which can be heated and which widens conically in order to guide a film melt toward an open side that can be closed with a lid (13), and which has ribs (4) for dividing the melt film into fibers that grow rigid after leaving the hollow reactor (1); and said improved quality can be achieved specifically in that the hollow reactor (1) is vertically oriented and exhibits a continuously curved inner wall and at the curved upper side exhibits an opening (3) for introducing the polymer melt, and in that a rotating distributor plate (12) is positioned opposite the opening (3), at a slight distance from the inner wall of the hollow reactor (1).

(Figure 1)

Li/ho

ABSTRACT OF THE DISCLOSURE

1. Fibers of improved quality can be produced with a reduced energy input in a device for producing synthetic fiber materials which has a polymer melt feed leading to a rotating hollow reactor (1), the wall of which can be heated and which widens conically in order to guide a film melt toward an open side that can be closed with a lid (13), and which has ribs (4) for dividing the melt film into fibers that grow rigid after leaving the hollow reactor (1); and said improved quality can be achieved specifically in that the hollow reactor (1) is vertically oriented and exhibits a continuously curved inner wall and at the curved upper side exhibits an opening (3) for introducing the polymer melt, and in that a rotating distributor plate (12) is positioned opposite the opening (3), at a slight distance from the inner wall of the hollow reactor (1).

GRAMM, LINS & PARTNER
Patent- und Rechtsanwaltssozietät
 Gesellschaft bürgerlichen Rechts

GRAMM, LINS & PARTNER GbR, Theodor-Heuss-Str. 1, D-38122 Braunschweig

Microfaser Produktionsgesellschaft mbH
 Steinweg 60

38518 Gifhorn

Braunschweig:

Patentanwalt Prof. Dipl.-Ing. Werner Gramm*
 Patentanwalt Dipl.-Phys. Dr. jur. Edgar Lins*
 Rechtsanwalt Hanns-Peter Schrammek
 Patentanwalt Dipl.-Ing. Thorsten Rehmann*
 Patentanwalt Dipl.-Ing. Justus E. Funke*⁺(†1997)
 Rechtsanwalt Christian S. Drzymalla
 Patentanwalt Dipl.-Ing. Hans Joachim Gerstein*
 Rechtsanwalt Stefan Risthaus

Hannover:

Patentanwältin Dipl.-Chem. Dr. Martina Läufer*

★ European Patent Attorney
 ° European Trademark Attorney

Ihr Zeichen/Your ref.:

Unser Zeichen/Our ref.:
 3129-002 US.-1

Datum/Date
 30. Juli 2001

Patentansprüche

1. Vorrichtung zur Herstellung von synthetischen Faserstoffen mit einer Zuführung für eine Polymerschmelze zu einem rotierenden Hohlreaktor (1), dessen Wandung aufheizbar ist, sich zur Führung eines Schmelzfilms zu einer offenen, mit einem Deckel (13) verschließbaren Seite hin konisch erweitert und mit Rippen (4) zur Aufteilung des Schmelzfilms in nach dem Austritt nach dem Hohlreaktor (1) erstarrende Fasern versehen ist, **dadurch gekennzeichnet, dass** der Hohlreaktor (1) vertikal ausgerichtet ist und eine stetig gekrümmte Innenwandung und an der gekrümmten Oberseite eine Öffnung (3) für die Zuführung der Polymerschmelze aufweist und dass gegenüber der Öffnung (3) ein rotierender Verteilerteller (12) in einem geringen Abstand zur Innenwandung des Hohlreaktors (1) angeordnet ist.
2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, dass der Abstand des Verteilertellers (12) zur Innenwandung des Hohlreaktors (1) einstellbar ist.

Antwort bitte nach / please reply to:

Hannover:

Freundallee 13
 D-30173 Hannover
 Bundesrepublik Deutschland
 Telefon 0511 / 988 75 07
 Telefax 0511 / 988 75 09

Braunschweig:

Theodor-Heuss-Straße 1
 D-38122 Braunschweig
 Bundesrepublik Deutschland
 Telefon 0531 / 28 14 0 - 0
 Telefax 0531 / 28 14 0 - 28

3. Vorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, dass der Verteilerteller (12) eine zur Öffnung (3) hin zeigende und zum Rand hin ansteigende Oberfläche aufweist.
- 5 4. Vorrichtung nach Anspruch 3, dadurch gekennzeichnet, dass der Verteilerteller (12) eine zur Öffnung (3) zeigende konkav gekrümmte Oberseite aufweist.
- 10 5. Vorrichtung nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, dass auf dem Verteilerteller (12) ein Kegelstumpf (11) angeordnet ist, dessen Durchmesser kleiner als der Durchmesser des Verteilertellers (12) ist.
- 15 6. Vorrichtung nach Anspruch 5, dadurch gekennzeichnet, dass der Durchmesser des Kegelstumpfs (11) größenordnungsmäßig dem Durchmesser der Öffnung (3) der Zuführung entspricht.
- 20 7. Vorrichtung nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, dass die Innenwandung des Hohlreaktors (1) parabolisch geformt ist.
- 20 8. Vorrichtung nach einem der Ansprüche 1 bis 7, dadurch gekennzeichnet, dass die Rippen (4) auf der Innenwandung des Hohlreaktors (1) im unteren Bereich senkrecht zum Rand (2) verlaufen.
- 25 9. Vorrichtung nach einem der Ansprüche 1 bis 8, dadurch gekennzeichnet, dass der Hohlreaktor (1) mit einem umgebenden Behälter (5) einen gekrümmten Spalt (6) bildet, an dem eine Dampfzuführung und eine Dampfableitung angeschlossen ist.
- 30 10. Vorrichtung nach Anspruch 9, dadurch gekennzeichnet, dass die Dampfzuführung und die Dampfableitung am oberen und unteren Rand des Hohlreaktors (1) angeordnet sind.

11. Vorrichtung nach Anspruch 9 oder 10, dadurch gekennzeichnet, dass der Dampf in einem Kreislauf durch den gekrümmten Spalt (6) geleitet wird.

5 12. Vorrichtung nach Anspruch 11, dadurch gekennzeichnet, dass der Dampf im Gleichstrom zu der auf der Innenwandung des Hohlreaktors (1) in Form eines Films fließenden Schmelze durch den gekrümmten Spalt (6) geleitet wird.

10 GRAMM, LINS & PARTNER GbR
Li/ho

GRAMM, LINS & PARTNER
Patent- und Rechtsanwaltssozietät
Gesellschaft bürgerlichen Rechts

GRAMM, LINS & PARTNER GbR, Theodor-Heuss-Str. 1, D-38122 Braunschweig

Microfaser Produktionsgesellschaft mbH
Steinweg 60

38518 Gifhorn

Braunschweig:

Patentanwalt Prof. Dipl.-Ing. Werner Gramm*°
Patentanwalt Dipl.-Phys. Dr. jur. Edgar Lins*°
Rechtsanwalt Hanns-Peter Schrammek
Patentanwalt Dipl.-Ing. Thorsten Rehmann*°
Patentanwalt Dipl.-Ing. Justus E. Funke*° (†1997)
Rechtsanwalt Christian S. Drzymalla
Patentanwalt Dipl.-Ing. Hans Joachim Gerstein*°
Rechtsanwalt Stefan Risthaus

Hannover:

Patentanwältin Dipl.-Chem. Dr. Martina Läufer*°

* European Patent Attorney
° European Trademark Attorney

Ihr Zeichen/Your ref.:

Unser Zeichen/Our ref.:
3129-002 US-1

Datum/Date
30. Juli 2001

Vorrichtung zur Herstellung von synthetischen Faserstoffen

Die Erfindung betrifft eine Vorrichtung zur Herstellung von synthetischen Faserstoffen mit einer Zuführung für eine Polymerschmelze zu einem rotierenden Hohlreaktor, dessen Wandung aufheizbar ist und zur Führung eines Schmelzfilms zu einer offenen, mit einem Deckel verschließbaren Seite hin konisch erweitert und mit Rippen zur Aufteilung des Schmelzfilms in nach dem Austritt aus dem Hohlreaktor erstarrende Fasern versehen ist.

Derartige synthetische Faserstoffe können insbesondere als Absorptionsmittel eingesetzt werden, die aus Wasser Erdöl und Erdölprodukte sowie eine Reihe von Schwermetallionen herausfiltern können.

Der Prozess zur Erzeugung von thermoplastischen Faserstoffen vollzieht sich regelmäßig in zwei Etappen, nämlich Gewinnung der Schmelze und Ausbildung der Faser.

Antwort bitte nach / please reply to:

Hannover:

Freundallee 13
D-30173 Hannover
Bundesrepublik Deutschland
Telefon 0511 / 988 75 07
Telefax 0511 / 988 75 09

Braunschweig:

Theodor-Heuss-Straße 1
D-38122 Braunschweig
Bundesrepublik Deutschland
Telefon 0531 / 28 14 0 - 0
Telefax 0531 / 28 14 0 - 28

In bekannten Anlagen wird das thermoplastische Material zuerst geschmolzen und dann die Schmelze durch Spinndüsen extrudiert, um die Fasern auszubilden. Eine durch SU 1 236 020 A bekannte Anlage verfügt über einen Beschickungsbunker, eine Stromversorgung und ein Schmelzgitter mit einem Verteiler für aufgeheiztes Inertgas. Die Verteiler sind dreikantartig ausgebildet und gleichmäßig über die Oberfläche bildende Schmelzgitter verteilt. Das zu verarbeitende thermoplastische Material wird in dem Raum über dem Gitter bis zur schmelznahen Temperatur gleichmäßig aufgeheizt und kann ungehindert zwischen den dreikantartigen Verteilern durchlaufen, wobei eine Behandlung mit Stickstoff stattfindet. Im Gehäuse des Schmelzgitters befinden sich Anschlussstellen für die Montage von Heizelementen. Dadurch wird das aufgeheizte Material geschmolzen und gelangt weiter zu einem Schneckentrieb, wird durch die Düsen gedrückt und zu einem Strang oder einem Faden ausgeformt. Mit Anlagen dieser Art können Fasern nur aus hochwertigen Rohstoffen hergestellt werden, wobei sichergestellt sein muss, dass der Rohstoff in gleichmäßigem Tempo auf das Schmelzgitter und anschließend die Schmelze auf die Schnecke für den Abtransport gelangt.

Durch GB 1 265 215 und SU 669 041 A sind Anlagen bekannt, bei denen die Faserergewinnung aus einem Band der Schmelze erfolgt, sodass die Gleichmäßigkeit des Durchflusses der Schmelze nicht kritisch ist. Dabei wird das Band aus der Schmelze an der Kante des rotierenden Reaktors in einzelne Stränge aufgeteilt. Der Reaktor ist ein horizontal angeordnetes rotierendes zweigeteiltes Becken mit einem Hohlraum und einer Arbeitsoberfläche. Im Hohlraum befinden sich spaltähnliche Öffnungen. Ein Energieträger dringt aus dem äußeren Hohlraum des Reaktors durch die spaltähnlichen Öffnungen ein und trennt das Schmelzband in einzelne Stränge, bearbeitet sie von zwei Seiten, macht sie dünner und zieht sie zu Fasern. Um mit dieser Anlage eine qualitativ hochwertige Faser zu erhalten, muss der Energieträger eine höhere Temperatur als die Destruktionstemperatur des Polymers sowie eine ausreichende Geschwindigkeit haben, damit die Schmelzstränge dünner und länger und somit zu einer Faser geformt werden können. Das geöffnete Becken des Reaktors bedingt einen Energieverlust und führt zu einer verringerten Effektivität des Herstellungsverfahrens.

Durch RU 2 061 129 ist ferner eine Anlage zur Erzeugung von Faserstoffen bekannt, die einen Extruder, einen Faser bildenden Ringkopf mit radial angeordneten und im Zentrum zusammenlaufenden Kanälen, einen Luftstromerzeuger, der die Schmelzstränge gleichzeitig in die Länge zieht und abkühlt, bis sie zu Fasern geworden sind, und ein Element zum Abscheiden der fertigen Faser aufweist, dass
5 eine in Richtung des eintreffenden Fadens konvergierende Erweiterung aufweist. Das Ablegen der Fasern erfolgt unter dem Einwirken eines straffen Luftstromes, der in Richtung der extrudierten Schmelzstränge gerichtet ist. Die radial angeordneten und im Zentrum zusammenlaufenden Kanäle erfordern ebenfalls den Einsatz von hoch-
10 qualitativen Rohstoffen. Andernfalls werden diese Kanäle mit nicht vollständig geschmolzener Masse verstopfen, wodurch die Weiterleitung durch die Schmelzleitungen erschwert wird. Die Herstellung von qualitativ hochwertigen Fasern aus weniger hochwertigen Rohstoffen ist somit nicht möglich.

15 Aus RU 2 117 719 ist eine Vorrichtung der eingangs erwähnten Art bekannt, bei der ein horizontal angebrachter rotierender zylindrischer Hohlreaktor von außen erhitzt wird. Der offene Teil des Reaktors hat die Form eines sich erweiternden Konus, der mit einem unbeweglichen Konusdeckel verschlossen ist. Der Konusdeckel bildet mit den seitlichen Oberflächen des sich erweiternden Konus eine Spaltöffnung von 15 bis 20 mm. Zusätzlich sind an der inneren Oberfläche des Reaktors
20 flache Rippen angebracht, die über ihre Länge eine Dreiecksform aufweisen, die entlang der Faserbildung und mit der Spitze in Richtung des Schmelzflussaustritts ausgerichtet ist. Die Vorrichtung ist mit einer ringförmigen Hochdruckluftzufuhr ausgerüstet. Mit dieser bekannten Vorrichtung ist es möglich, die Verarbeitung von
25 thermoplastischem Material aus Industrie- und Hausmüll unter gleichzeitiger Erhöhung des Ausstoßes von hochwertigem Fasermaterial zu realisieren. In der Praxis ist jedoch das Problem aufgetreten, dass mit den üblichen Heizelementen bei einer Zylinderform des Reaktors eine gleichmäßige Erwärmung von Reaktorwand und
-boden nicht erreicht werden kann. Daher ist die Temperatur des Reaktorbodens
30 und der Endstücke stets niedriger als die der Reaktorwand. Die Schmelze sammelt sich in den Ecken zwischen der Wand und dem Boden und bildet somit eine Art Stillstandszone, wo sich die Schmelze abkühlt und dazu neigt, am Boden und an

den Übergängen des Bodens zu den Wänden anzuhaften. Die Bildung solcher Stillstandszone
vermindert die Produktivität der Anlage und wirkt sich negativ auf die Faserqualität aus. Feste Teile des Polymers können aus dieser Stillstandszone mitgerissen und unter Einwirkung der Zentrifugalkräfte zusammen mit der Schmelze
5 zum Endstück des Reaktors befördert und zusammen mit der Faser ausgebracht werden, wodurch die Faser ungleichmäßig mit Verdickungen oder Einschlüssen fester ungeschmolzener Stücke verschiedener Form ausgebildet, die Qualität der Faser also vermindert wird. Zum Reinigen der Stillstandszone muss die Anlage regelmäßig angehalten werden, um das anhaftende Polymer mechanisch zu entfernen.
10 Würde man die Reaktorwände stärker erhitzen, führt dies zu einer wesentlichen Überhitzung des Schmelzfilmes. Ein weiterer Nachteil der bekannten Vorrichtung besteht darin, dass etwas mehr als 30 % der zugeführten Wärmeenergie unmittelbar für die Erwärmung des Bandes verwendet wird. Die restliche, vom Erhitzer abgegebene Energie wird für das Aufheizen des Reaktorinneren und der Umgebungsluft durch Übertragung von Strahlungsenergie verbraucht. Ferner tritt wegen der
15 Rückstrahlung zwischen dem Erhitzer und dem Reaktor im zentralen Teil des Reaktors eine Überhitzung der Heizelemente und des Schmelzbandes auf. Das kann einerseits zum Verbrennen der Erhitzer und andererseits zu einem nicht zu vernachlässigen oder sogar völligen Ausbrennen des Polymers führen. Bei einer gleichmäßigen
20 Verteilung der Kapazität des Erhitzers in radialer und axialer Richtung sammelt sich die Hauptmenge der Wärme im oberen Teil des Erhitzers. In diesem Fall ist auch eine Überhitzung und ein Verbrennen der Heizelemente möglich.

Der vorliegenden Erfindung liegt die Aufgabe zugrunde, eine Vorrichtung zur Herstellung von synthetischen Faserstoffen der eingangs erwähnten Art so zu verbessern,
25 dass mit einem verringerten Energieverbrauch eine erhöhte Faserqualität erzielt wird.

Diese Aufgabe wird bei einer Vorrichtung der eingangs erwähnten Art erfindungsgemäß dadurch gelöst, dass der Hohlreaktor vertikal ausgerichtet ist und eine stetig gekrümmte Innenwandung und an der gekrümmten Oberseite eine Öffnung für die
30 Zuführung der Polymerschmelze aufweist und dass gegenüber der Öffnung ein ro-

tierender Verteilerteller in einem geringen Abstand zur Innenwandung angeordnet ist.

Die erfindungsgemäße Vorrichtung ist zur Herstellung eines gleichmäßigen dünnen Schmelzfilms ausgebildet, der sich zur offenen Seite des Reaktors aufgrund der stetigen Krümmung der Innenwandung ohne Stillstandszonen bewegen kann. Die Ausbildung des gleichmäßigen dünnen Schmelzfilms gelingt dadurch, dass die Polymer-
schmelze axial an der gekrümmten Oberseite des Hohlreaktors durch eine Öffnung
zugeführt wird und dort auf einen rotierenden Verteilerteller gelangt, der in einem
geringen Abstand zur Innenwandung des Hohlreaktors angeordnet ist. Dadurch wird
das zugeführte geschmolzene Polymer gesammelt und durch die Zentrifugalkraft
gleichmäßig auf die Innenwand des Hohlreaktors geschleudert. Der Verteilerteller
bildet somit einen Verschluss der Zuführungsöffnung unter Ausbildung eines Ring-
spalts mit der Innenwandung des Hohlreaktors, aus dem das auf dem Verteilerteller
gesammelte Material gleichmäßig verteilt austritt und auf die Innenwandung des
Hohlreaktors gelangt. Die Fließgeschwindigkeit des Schmelzfilms auf der Innen-
wandung des Hohlreaktors wird durch die aufgrund der Rotation des Hohlreaktors
resultierende Zentrifugalkraft und zusätzlich durch das Gewicht des Schmelzfilms
bestimmt, da der Hohlreaktor vertikal und nach unten offen ausgerichtet ist.

20

Die Verteilerwirkung des Verteilertellers wird noch dadurch verbessert, dass die Oberfläche des Verteilertellers zum Rand hin ansteigt, vorzugsweise eine zur Öffnung zeigende konkav gekrümmte Oberseite bildet. In einer bevorzugten Ausführungsform ist auf dem Verteilerteller ein Kegelstumpf angeordnet, dessen Durchmesser kleiner als der Durchmesser des Verteilertellers ist. Dabei kann der Durchmesser der Oberseite des Verteilertellers größenordnungsmäßig dem Durchmesser der Öffnung der Zuführung entsprechen.

25

Die stetig gekrümmte Innenwandung des Hohlreaktors ist vorzugsweise parabolisch
ausgebildet, entspricht also der Oberfläche, die durch die Rotation einer Parabel um
die eigene Achse entsteht. Bei gleicher Höhe und bei gleichem Durchmesser der
Austrittsöffnung entsteht durch die stetige Krümmung gegenüber der vorbekannten

30

Vorrichtung ein wesentlich verringertes Innenvolumen, sodass sich die benötigte Wärmeenergiemenge für das Aufheizen des Innenraumes verringert. Die erfindungsgemäße Konstruktion minimiert auch die Wärmeverluste und den spezifischen Wärmeverbrauch.

5

In einer besonders bevorzugten Ausführungsform der Erfindung bildet die Innenwandung mit einem umgebenden Behälter des Hohlreaktors einen gekrümmten Spalt, an den eine Dampfzuführung und eine Dampfableitung angeschlossen ist. Durch die ständige Zirkulation von aufgeheiztem Wasserdampf durch den gebilde-

10 ten Hohlraum wird eine gleichmäßige Aufheizung der Reaktorwände erreicht. Somit ist es möglich, das Schmelzband bzw. den Schmelzfilm mit einer gleichmäßigen Temperatur und Dicke herzustellen, wodurch die Faser über die gesamte Länge einen gleichmäßigen Durchmesser aufweist und keine ungeschmolzenen Teile enthält. Hierzu ist es zweckmäßig, wenn die Dampfzuführung und die Dampfableitung

15 am oberen und unteren Rand der Innenwandung angeordnet sind. Der Dampf kann dabei sowohl im Gleichstrom als auch im Gegenstrom zu der Transportrichtung der Polymerschmelze geführt werden. Bevorzugt ist die Anordnung im Gleichstrom.

20

25

30

Die Erfindung soll im folgenden anhand eines in der Zeichnung dargestellten Ausführungsbeispiels näher erläutert werden. Es zeigen:

Figur 1 einen Vertikalschnitt durch ein Ausführungsbeispiel einer erfindungsgemäßen Vorrichtung

Figur 2 eine Teilansicht auf einen zwischen Innenwand und Deckel ausgebildeten Ringspalt.

Die in der Zeichnung dargestellte Vorrichtung dient zur Erzeugung von Fasern aus einer Thermoplastschmelze und umfasst einen vertikal installierten rotierenden Hohlreaktor 1 in Form eines Paraboloids, der durch die Rotation einer Parabel um die eigene Achse gebildet wird. Am offenen Rand des Paraboloids ist ein sich als erweiternder Konus ausgebildeter Rand 2 vorgesehen. Zentrisch ist im gekrümmten Teil des Paraboloids eine Öffnung 3 zum Zuführen einer Polymerschmelze ausgebildet. Die Innenwandung des Hohlreaktors 1 ist mit flachen Rippen 4 versehen, die im unteren Bereich des Hohlreaktors 1 senkrecht zum Rand 2 verlaufen.

Der Hohlreaktor 1 befindet sich in einem umgebenden Behälter 5, in dessen Oberfläche der Form des Hohlreaktors 1 angepasst ist, sodass sich ein gekrümmter Spalt 6 ergibt. Der Spalt 6 ist in seinem oberen Teil mit dem Ausgang und in seinem unteren Teil mit dem Eingang eines Dampferzeugers 7 verbunden, sodass mit dem Spalt 6 ein geschlossener Dampfkreislauf gebildet wird. Die Bewegungsrichtung des Wasserdampfes ist in Figur 1 durch Pfeile verdeutlicht, wobei eine Gleichstrombewegung des Wasserdampfes ausgebildet wird. Durch eine Umkehrung des Wasserdampferzeugers 7 lässt sich in gleicher Weise und für manche Anwendungsfälle sinnvoll auch eine Gegenstromrichtung des Wasserdampfes realisieren.

Gegenüberliegend von der Öffnung 3 befindet sich innerhalb des Hohlreaktors 1 eine Verteilanordnung 8, die an einer zentrisch durch die Zuführungsöffnung 3 geführten Stange 9 befestigt ist. Die Stange 9 ist axial verstellbar, sodass der Ab-

stand der Verteileinrichtung 8 von der Innenwand des Hohlreaktors 1 einstellbar ist. Die Verteileinrichtung besteht in dem dargestellten Ausführungsbeispiel auf einem Kegelstumpf 11 und einem darunter angebrachten Verteilerteller 12, dessen Durchmesser größer als die Basis des Kegelstumpfs 11 ist. Kegelstumpf 11 und Verteilerteller 12 sind fest miteinander verbunden, vorzugsweise einstückig ausgebildet. Der über den Kegelstumpf 11 radial überstehende Ring des Verteilertellers 12 ist mit einer zum radialen Rand hin ansteigenden Oberfläche versehen und bildet so eine konkav gekrümmte Oberseite.

Der Hohlreaktor 1 ist am unteren offenen Ende durch einen scheibenförmigen Deckel 13 verschlossen. Die flachen Rippen 4 sind mit dem Rand des Deckels 13 verbunden, sodass sich zwischen den Rippen Austrittsöffnungen ergeben.

Der Hohlreaktor ist am Ende einer Hohlwelle 14 angebracht, die auf Lagern 15 rotierend gelagert ist. Die Lager 15 befinden sich in einem zu kühlenden Gehäuse 16. Am vom Hohlreaktor 1 entfernten Ende der Welle 14 ist eine Antriebsscheibe 17 zur Übertragung der Rotation beispielsweise von einem (nicht dargestellten) asynchronen Motor angeordnet.

Zur Erzeugung von Faserstoffen wird der Reaktor vor der Inbetriebnahme durch Zuführen von zirkulierendem Wasserdampf in den Spalt 6 auf Arbeitstemperatur gebracht. Da der Wasserdampfstrom eine konstante Temperatur und Geschwindigkeit hat, erfolgt das Aufheizen der Innenwand des Hohlreaktors 1 auf seiner gesamten Oberfläche gleichmäßig. Der Wärmestrom wird von der erhitzten Oberfläche des Hohlreaktors 1 nach innen abgegeben und erzeugt somit die erforderliche Temperatur im gesamten Innenraum und hält sie konstant. Auf diese Weise entsteht ein homogenes Temperaturfeld an der gesamten Oberfläche des Hohlreaktors 1.

Nach dieser Vorbereitung der Anlage wird der Hohlreaktor mit einer vorgegebenen Winkelgeschwindigkeit zum Rotieren gebracht. Danach wird durch die Hohlwelle 14 und den ringförmigen Verteilerspalt 10 die Polymerschmelze eingebracht. Die Schmelze gelangt zuerst auf den Kegelstumpf 11 und fließt dann auf den Verteiler-

teller 12. Durch die Konizität des Kegelstumpfs 11 nimmt die Geschwindigkeit des Schmelzflusses zu. Diese Geschwindigkeit erhöht sich durch das Laufen der Schmelze zum Rand des Verteilertellers 12. Der Verteilerteller 12 stellt somit eine Art Sammelvorrichtung dar, auf der die Schmelze gleichmäßig über den gesamten Teller verteilt wird. Durch das Ansteigen der Oberfläche des Verteilertellers 12 zum Rand hin entsteht eine zusätzliche Verdichtungskraft, sodass sich die Schmelze mit zunehmender Geschwindigkeit und Kraft als homogenes Band zur Peripherie des Verteilertellers bewegt. Nach Erreichen des Randes des Verteilertellers 12 reißt das Schmelzband ab und gelangt auf die Innenwandung des Hohlreaktors 1. Dort bewegt sich der Schmelzfilm nach unten, wobei die Bewegung nach unten durch die Erdanziehungskraft aufgrund der vertikalen Anordnung des Hohlreaktors 1 unterstützt wird. Nach Erreichen des Teils des Hohlreaktors, in dem sich die flachen Rippen 4 befinden, teilt sich der Schmelzfilm in verschiedene Stränge, die über den Rand 2 verlaufen und beim Abreißen von der Kante des konusartigen Randes 2 dünne Fasern bilden.

Eine ringförmige Luftzufuhr lenkt den entstandenen und sich abkühlenden Faden in eine Sammelvorrichtung.

Zusammenfassung

- 5 Mit einer Vorrichtung zur Herstellung von synthetischen Faserstoffen mit einer Zuführung für eine Polymerschmelze zu einem rotierenden Hohlreaktor (1), dessen Wandung aufheizbar ist, sich zur Führung eines Schmelzfilms zu einer offenen, mit einem Deckel (13) verschließbaren Seite hin konisch erweitert und mit Rippen (4) zur Aufteilung des Schmelzfilms in nach dem Austritt nach dem Hohlreaktor (1) erstarrende Fasern versehen ist, läßt sich eine verbesserte Qualität der hergestellten Fasern bei verringertem Energieeinsatz dadurch erreichen, dass der Hohlreaktor (1) vertikal ausgerichtet ist und eine stetig gekrümmte Innenwandung und an der gekrümmten Oberseite eine Öffnung (3) für die Zuführung der Polymerschmelze aufweist und dass gegenüber der Öffnung (3) ein rotierender Verteilerteller (12) in einem geringen Abstand zur Innenwandung des Hohlreaktors (1) angeordnet ist.
- 10
- 15

(Figur 1)

20 Li/ho

Antwort bitte nach / please reply to:

Hannover:

Freundallee 13
D-30173 Hannover
Bundesrepublik Deutschland
Telefon 0511 / 988 75 07
Telefax 0511 / 988 75 09

Braunschweig:

Theodor-Heuss-Straße 1
D-38122 Braunschweig
Bundesrepublik Deutschland
Telefon 0531 / 28 14 0 - 0
Telefax 0531 / 28 14 0 - 28

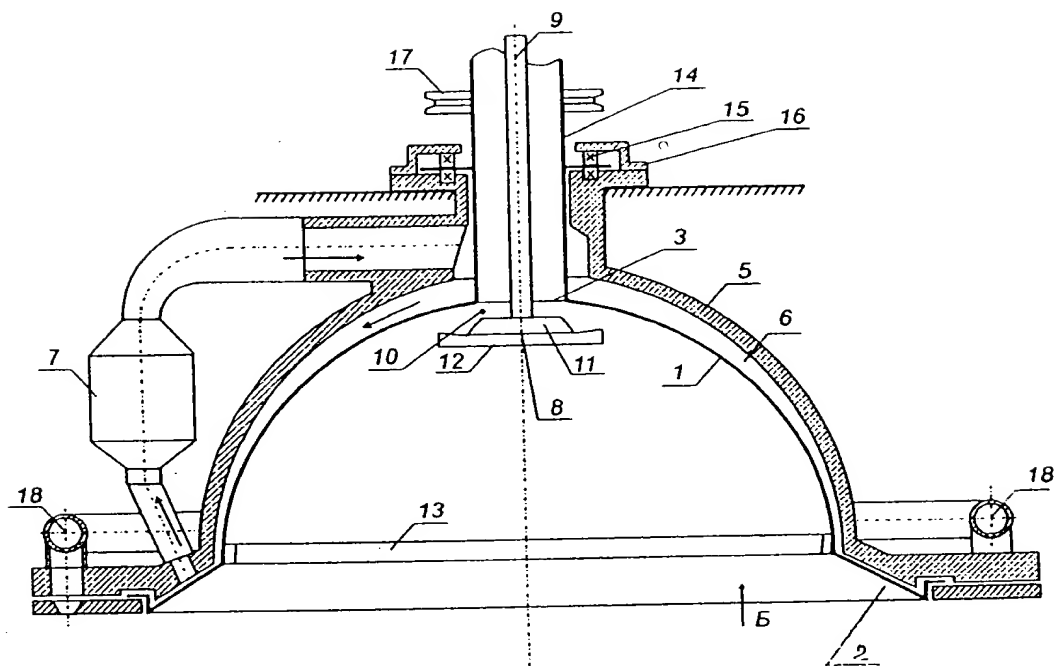


Fig. 1

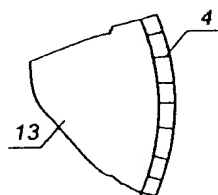


Fig. 2